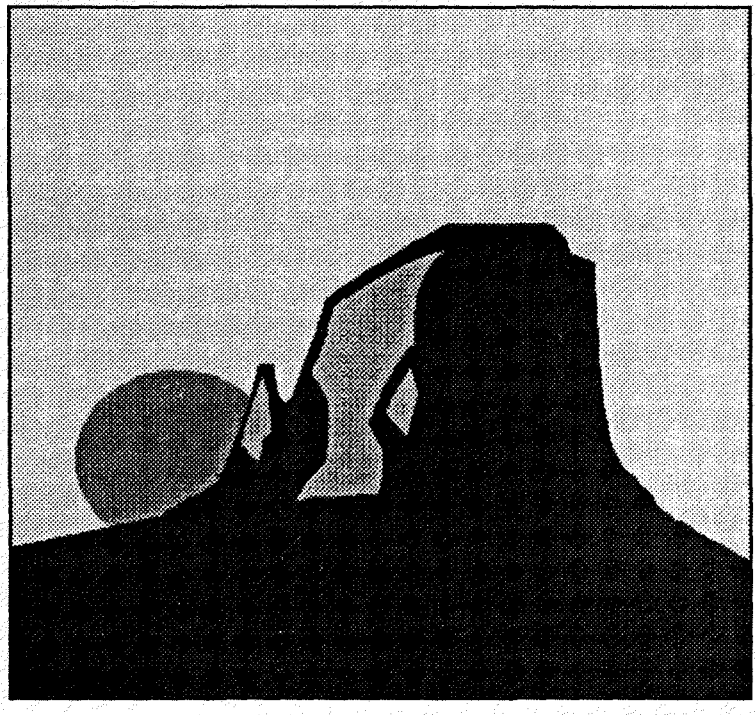
Creation/Evolution



Issue 38 Summer 1996

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About this issue. . .

This issue begins the final year of publication of *Creation/Evolution* in its current format. At its 1996 annual meeting, the NCSE board of directors agreed to combine the two NCSE publications, *NCSE Reports* and *Creation/Evolution* into a single publication that will publish six times each year. NCSE Executive Director Dr. Eugenie C. Scott gave details of this decision in the Spring, 1996 issue of *NCSE Reports* (16[1]:10-11). We will cease publication of *Creation/Evolution* as a separate entity after the winter, 1996 issue which will carry issue number 39.

The new combined publication, *Reports of the National Center for Science Education*, will combine the best of both of our current publications. It will continue to include news and updates from around the country (and the world) about successes and challenges in promoting evolution in science teaching and learning. Our new publication will also include the scholarly articles and book reviews that our readers have come to expect from *Creation/Evolution*. The new format will also allow us more space and flexibility to include commentaries, essays, and perspective or historical contributions that we have often received but have been unable to publish comfortably in either of our existing formats. Furthermore, the new publication format has the added incentive of providing all these features at a lower cost than our current practice of printing and distributing two different publications in two different formats on two different schedules.

We look forward to this change in the expectation that it will provide a better service to our members and readers and anticipate receiving a continuing stream of high-quality contributions. Prospective contributors should note changes in style requirements for submissions that will take effect with the first issue of *Reports of the National Center for Science Education* in January, 1997. Lest we overlook our current issue in our enthusiasm for our new format, we have an issue full of the quality and variety that you expect from *Creation/Evolution*. Simon Coleman and Leslie Carlin write from England about the status and history of religious anti-evolutionism in the United Kingdom. It may surprise many of us in North America that a nation that *does* establish an *official* state church would find less opposition to evolution than here at home where there is no established creed. Coleman and Carlin explore the historical and social conditions that relate to the differences on the other side of the Atlantic.

Lorence Collins provides our readers with a detailed look at polonium "halos"—traces of the decay of radioactive uranium—found in the Colorado Plateau. Collins explains how these are formed and how scientists interpret the ages of the strata where they are uncovered. His article confronts creationist writings by R. V. Gentry that claim that the polonium halos and the surrounding strata were formed suddenly after the Noachian Flood.

continued on inside back cover

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Creation/Evolution

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The journal of evolution and science education which explores aspects of evolution and anti-evolutionism

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No Contest: The Non-Debate Between Creationism and Evolutionary Theory in Britain

Simon Coleman and Leslie Carlin

The history of creationist controversies is associated with two great debates: Huxley versus Wilberforce at Oxford in 1860, and Darrow versus Bryan in Tennessee during the Scopes trial in 1925. However, if the American trial remains emblematic of political, educational and religious conflicts in the contemporary U.S.[1], in Britain the Oxford debate belongs largely to a quaint if distant episode in the nation's Victorian heritage. Even at the time of the Scopes episode, leading British clerics, scientists, and educators remained nonchalant at the thought of similar events' occurring in their own country. In a special supplement to *Nature* produced at the time, the Reverend Eric Waterhouse of Wesleyan College, Surrey, remarked (1925:79): "The great majority of clergy and ministers in Great Britain accept the theory of the evolution of species." More forcefully, the Right Reverend E.W. Barnes, Lord Bishop of Birmingham, took the opportunity to contrast the "ignorant fanaticism" of developments in the U.S. to the perceived "reasonable formulation of the Christian faith" in Britain (1925:74).

Referring to more recent attitudes, Berra (1990) argues that nowhere in western Europe has creationism been an important issue of debate. Thus Barker (1985:181) exaggerates only slightly in claiming that the educated public of post-war England has merely begun to countenance the possibility that people might believe Genesis was sustainable on scientific grounds. In support of her argument, she quotes a striking passage not from a secular text but from the *International Church Index* (1981:88): "There was an historical debate in the middle years of the last century. This is not now an issue concerning anyone." Admittedly, some religious groups in Britain, including Pentecostalists, Mormons, Jehovah's Witnesses and Seventh-Day Adventists, do reject evolution in favor of more literal interpretations of the Bible. However, the number of people included in these groups is unlikely to add up to more than a few hundred thousand people (Barker, 1985:182).

The important point is precisely that creationist views in Britain are marginal and largely confined to sectarian groups rather than the mainstream. Poll data from the U.S. (cf. Woodrum and Hoban, 1992:315), implying that 74% of people agree that biblical creation should receive as much weight in schools as the theory of evolution, seem truly incredible from a British perspective. For instance in both the U.K. and the U.S., the British Christian Education Movement has marketed a video on the interplay between science and religion, featuring both creationist and evolutionary views of human origins. According to a member of the movement (Blaylock, pers. comm.), U.S. educators tend to complain that there is

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"not enough about creationism." Their British counterparts, in significant contrast, comment that the material actually contains too much about precisely the same subject.

In this paper, we examine the British experience of creationism, contrasting it with the past and present situation in the U.S. It might seem paradoxical that a European nation whose union of church and state is still largely intact should display such an unproblematic acceptance of theories of evolution. However, our aim is to uncover the varied factors contributing to the relative lack of widespread, public controversy associated with such ideas. We shall therefore examine not only historical factors but also the extent to which the political, legal, and religious contexts of the country have proved unconducive to the success of a minority social movement such as that of the anti-evolutionists. A particular focus will be on the teaching of evolution in schools. In the U.S. this issue has proved to be a key symbolic and legislative battleground between opposing viewpoints, whereas in Britain it has largely proved irrelevant. Finally, we speculate upon the possibility that, under changing cultural and political conditions, creationism could become a more active force in the British Isles.

Creationist Groups In Britain

When it appeared in 1859, Darwin's *Origin of Species* provoked considerable interest and not a little controversy in Britain. However, Darwin's ideas soon gained increasing acceptance, if not complete comprehension, from metropolitan centers in the country, even if more peripheral areas continued to read the Bible literally (Ruse, 1982:286). Evolution never became a great bone of contention among British evangelicals (Bebbington, 1989:207). Neither did opposition to the new theory ever become an effective, well-organized movement.

Admittedly, there was *some* anti-evolutionary reaction in 19th century Britain. The Victoria Institute was formed in 1865 to act as a forum for those opposed to evolution. In 1897, the Institute had 1,246 members, some of them Fellows of the Royal Society (Numbers, 1992:141). Twenty years further on, though, the Institute's outlook had become decidedly liberal, and it advocated theistic evolution rather than creationism. Its membership had dropped dramatically, and those who remained were deemed apathetic by a visiting Canadian, George McCready Price, who had been active in the North American creationism movement. Price, in turn, was viewed skeptically by the British when he attempted to promote a more strident anti-evolutionary position[2]. According to Numbers (1992:142), Price wrote home that he was "somewhat disappointed in the apparent lethargy of the friends of the Bible over here, regarding the subject of evolution."

In the significant year of 1925, a spokesman for the Christian Evidence Society stated that in Europe there appeared to be much less interest in the relationship between science and religion "owing to the fact that religious people do not oppose the findings of natural science today; and men of science do not attack religion" (quoted in Bebbington, 1989:207). Nevertheless, some opposition to evolution appeared in the 1920s, and the early 1930s saw the gradual formation of the Evolution Protest Movement (EPM) with the electrical engineer Sir Ambrose Fleming as its president. The movement published scientific evidence in support of the Bible, as well as trying to influence both the Board of Education and the British Broadcasting Corporation (BBC), but it gained little public support. As Bebbington (1989:209) remarks of this group: "That it existed is evidence for an element of anti-evolutionary thinking in conservative evangelicalism; that it remained small is evidence for the weaknesses of the cause, even among evangelicals."

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By the 1960s, the EPM had become relatively inactive. However, since then, a number of significant changes have occurred within British creationist circles — changes which have reflected a more global expansion of evangelical and specifically anti-evolutionary ideas (cf. Locke, 1994:407). Whitcomb and Morris's *The Genesis Flood* came out in 1961, and the EPM helped distribute it in Britain. In 1963, the Creation Research Society, propounding a recent creation philosophy, was formed in the U.S. These events, along with conservative evangelical reactions against liberal theologies in the U.K., helped to provide the EPM with new momentum and a new direction. In 1980, the membership changed its name to the Creation Science Movement (CSM) implying a more active attempt to create a scientifically valid alternative to the question of human origins. By the mid 1980s over 80% of the Movement members were professing themselves to be "young earthers" (Numbers, 1992: 327), and toward the end of the decade its chairman was claiming the support of some 1300 people (Locke, 1994). In recent years the group has continued to distribute its journal *Creation* as well as bringing out a newspaper aimed at teenagers called *Original View*.

Just as the period since the 1960s has seen some significant changes in the fortunes and philosophy of the CSM, so it has produced a number of new creationist organizations in the country. The Biblical Creation Society was founded in the late 1970s by a group of evangelical Christians. By the early 1980s it had a membership of some 700 people, ranging from "young earthers" to "mature earthers" (who believe the earth was created 6,000 years ago but looks older) to gap theorists (Howgate and Lewis 1984:703). As the name of the group implies, its members have consciously avoided what has been seen as the North American tendency to shy away from using the Bible as a weapon in debate. For example, in the group's journal, *Biblical Creation*, an editor comments disapprovingly on the idea that scientific creationism can survive as a non-religious entity:

> It is clear that these strange ways of thinking have been called forth by the peculiar character of the American constitution, and the need to fight the U.S. educational system on its own terms....[W]e should not uncritically swallow the idea that such a distinction has any validity [outside a U.S. court of law] (de S. Cameron, 1981:6-7).

Other organizations which have appeared on the British creationist scene include the now-defunct Newton Scientific Association (cf. Numbers, 1992:325) which did attempt, like some U.S. organizations, to limit its discussions to overtly scientific questions. Barker (1985:190) notes that in 1977 a newsletter called *Daylight* was started to support parents opposed to evolutionist teaching in Catholic schools, and indeed a Catholic Creation Society was also formed. Further influence of creationist ideas was evident in an exhibition on Darwinism put on in the Natural History section of the British Museum in 1981. The curators chose to present Darwinian evolution as "one possible explanation" of human origins (cf. Hayward, 1985:13). Darwin's theory was juxtaposed with another view — "that God created all living things perfect and unchanging." This decision to give intellectual space to a creationist viewpoint was described by *Nature* as proclaiming "Darwin's death in South Kensington [London]" (26 February, 1981:735; also in Hayward 1985:13).

Britain: Religious, Social and Political Context

The overall picture we have given of creationism in Britain has been of a small number of relatively obscure groups, each generally made up of hundreds rather than thousands of

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members. To a certain extent these groups have had overlapping memberships, tolerating some internal divergences of views. However, each of the groups has exhibited some differences in emphasis, for instance over the degree to which religious and scientific discourses should be mixed together. Although influenced and even reinforced by developments in the U.S., the groups have also demonstrated some desire for national autonomy as well as a concern over the extent to which they might be unduly influenced by American-style forms of fundamentalism. Undoubtedly, British creationists have had a much lower public profile than their counterparts in the U.S., even though they share some of the same aims, such as access to the media and the chance to educate children in their ideas.

In order to understand the low public profile of creationism in Britain we must identify structural features that might encourage or restrain minority protest movements, beginning with recent trends in religious belief and worship. Belief in and knowledge of Christian doctrines and practices are declining among the British, even if 66-75% of the population maintain fairly consistently that they believe in some notion of God (Davie, 1994:74-5). The Anglican Communion has developed a form of all-inclusive internal diversity or "fudged accommodation" (Bruce 1995:94) incorporating a vast range of liturgies and attitudes within clergy as well as laity. In a book specifically devoted to religious education, Newbigin remarks (1990:98): "When a theologian in our culture appeals to 'biblical authority' he is met with politely raised eyebrows."

Alongside the softening of the mainstream religious center and a loss of the authority of mainline churches in the post-war period, there has been an increase in such forms of non-Christian pluralism as Islam, Hinduism, Sikhism, and New Religious Movements. Most interestingly from the perspective of this paper, however, some firming on the right of the Anglican and broadly Protestant Christian spectrum has become evident over the past two decades or so. Evangelicals have not only been bolstered by the incentive to react against a liberalizing faith but have also proved more successful than other Christians at retaining younger generations within the religious fold. The House Church Movement and some Afro-Caribbean churches have expanded, and U.S. evangelists have found some British audiences for their campaigns. Recent years have seen growing numbers of Christian schools attached to independent churches, sometimes of North American origin (Davie, 1994:136). Despite apparently encouraging signs for religion, especially of the conservative Christian variety, it must be remembered that the proportion of active believers in Britain is still small compared to that in the U.S. Over half of the North American population not only claims church membership but actually regularly attends services; in Britain less than 20% claim membership and fewer attend church (Bruce, 1990:69). An important aspect of the visibility of conservative Christianity in the U.S. is its ability to appropriate the electronic media—especially as in recent years such Christians have grown more prosperous; in Britain (partly for reasons discussed below) televangelists have made little progress. Few potential viewers are even aware that these preachers are available on cable or satellite broadcasts.

Not only are there far fewer evangelicals in Britain than in the U.S.—both in absolute terms and as a proportion of the total population—but the character of conservative Christianity in Britain is also rather different. In the U.S., such Christians have more extensive contemporary support combined with a history of having been, as far as was possible, the dominant, mainstream faith of the country in the 19th century. As a result, both the rhetoric and the aspirations of a religious majority have been retained, particularly since the revivals of the 1970s. In contrast, as Numbers (1992) notes, British evangelicalism has always been in a minority position and consequently has developed a stronger tradition of tolerance towards others—or at least a greater concern to keep a low theological profile. Bebbington

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writes: "In Britain...the weakness of separatist fundamentalism meant that there was too narrow a social base for any counterpart to the 'Moral Majority'" (1994:377). Even in *Biblical Creation*, in an article discussing the teaching of human origins in schools, the author accepts the need to present the theory of evolution while also pointing out its weaknesses and stresses the need to avoid mocking others who hold different views (Peet, 1982).

Even if British evangelicals had managed to gain a greater membership throughout this century, a number of factors would have hindered their attempts to gain a powerful voice in the religio-political mainstream. Those with access to sufficient organizational and financial resources can gain access to the American airwaves, and indeed some televangelists concentrate on "media ministries" alone. Most of the British media are rather more paternalistic and centralized in orientation. The BBC has in the past acted almost as the communicative equivalent of the Church of England, seeking to be internally tolerant within limits and certainly deciding what would be sufficiently educational and informative for its listeners and viewers. In religious terms, British broadcasting has moved in recent years towards a form of pluralism whereby representatives of different Christian denominations and non-Christian religions have been given some time on the airwaves. The Broadcasting Act of 1990 has in certain respects opened up electronic media to market forces, but broadcast channels have still generally been required to give time to denominations roughly in accordance with their size (Bruce, 1995:55). The result has been to present a view of religion as essentially tolerant and ecumenical and, paradoxically, to edit out views considered extreme. Even the country's first exclusively religious radio station (Premier), which started broadcasting in 1995, has had to keep its message as noncontroversial and all-inclusive as possible in order to attract both advertisers and a sufficiently large share of the listening audience. In a context where deregulation has still not penetrated deeply and where money cannot buy mainstream broadcasting time, British creationists have concentrated much effort in breaking the perceived monopoly of the airwaves by liberals and evolutionists, but with relatively little success. As Numbers puts it (1992:329): "If British creationists envied one aspect of life in America it was 'freedom of the air'."

Not only are creationists—and evangelicals in general—denied widespread access to the media in Britain, but their ability to engage in the political process has been much more restricted. As Bruce notes (1990:125), in the U.S. the relatively more decentralized legislative and electoral systems have allowed well-organized interest groups to make their agenda seem salient, at least at local levels where concentrations of conservative Protestant populations may exist. Such groups can also of course invoke the rhetoric of minority rights and free speech in making their cases. In Britain, despite apparent governmental support for the values of individual responsibility and local community action, political power resides firmly in national, Parliament-controlled policies, while the courts are presided over by a judiciary appointed by a government politician, the Lord Chancellor.

Creationism in Education

From the first appearance of Darwinian theory, its supporters appear to have seized the initiative in British education—Thomas Huxley, for example, was a member of the London School Board. The centralization of the educational system over the last century, the diffuse influence on schools of the Church of England, and the small size of creationist groups all appear to be factors here. With the increase in non-Christian pupils in schools since the Second World War, evolutionary theory has at least had the virtue of not favoring any one religion's notion of human origins over any other.

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The 1944 Education Act made religious worship and religious education (RE) in British schools a legal requirement for the first time (Cox, 1989:1). It was tacitly assumed that (particularly Protestant) Christianity was the faith pupils would follow, although it was also assumed that no particular denomination would be favored in school assemblies. Accordingly, syllabi for each school district were to be decided by local bodies consisting of representatives from the Church of England, religious denominations, local political authorities and teachers' associations. The 1988 Education Act has sought to update rather than radically to alter the earlier legislation. It allows more influence from non-Christian bodies in local areas where this is relevant and partially reflects the growing need for a multicultural perspective. However, it also stated that forms of worship and syllabi should indicate the fact that Britain is a broadly Christian country.

In the U.S., where religion is theoretically barred from public schools, science curricula have been the main policy target of creationists seeking "balanced treatment" of evolution with the Biblical story of creation. Individual school districts have found themselves pressured to drop evolution from the high school curriculum or to teach creationism alongside it. High school biology curricula in such states as Ohio were giving equal time to evolution and creationism in the 1980s (Berra, 1990). At that time over 20 states had "balanced treatment" bills waiting to be enacted (Locke, 1994).

British schools do not have to present creationism as a scientific alternative to theories of evolution in order to avoid charges of violating the separation between church and state. However, evolution is taught largely without protest in schools. In 1977 the head of a school's religious education department in England was actually dismissed because he refused to teach his county's agreed syllabus which treated the creation story as a myth (Barker, 1985:183).

The extent to which British teaching practices accept theories of evolution as well as a relatively pluralistic, or at least comparative, orientation toward religion is revealed in an examination of current biology and religious studies programs. For instance, a biology syllabus for secondary-level (i.e. 11-18 year-old) pupils (Northern Examinations and Assessment Board, 1996:7-19) includes a section on the knowledge of "selection, evolution and genetic engineering." The pupil is expected to learn that species have become extinct and that fossils provide information about adaptation and natural selection. The course does ideally include discussion of "social and ethical issues," but specifies that these are related to genetic engineering, selective breeding and cloning. Evolution *per se*, it is assumed, is not "an issue."

Such an approach can be compared with a sample from one religious education syllabus for secondary schools (Lohan and McClure, 1988). The Christian Education Movement, which is devoted to a liberal approach to teaching Christianity, has identified what it calls "Common Areas of Content" (Blaylock, pers. comm.). These include "the origins and order of the universe" and "the place of humanity." We see here some familiar themes in contemporary religion, including a form of ecumenism that is consciously inclusive and internally diffuse. Course books have such titles as *Community, People, Story* (Lohan and McClure, 1988a) and *Communication, Celebration, Values* (Lohan and McClure, 1988b). The former of these two volumes includes a section on origins. Pupils are encouraged to read the "creation story" in Genesis and then reflect on their interpretations of these biblical passages; were the writers of the passage constructing "a story about their belief in a God who creates a good world [or] a scientific account about exactly how the world developed?" (p. 32). The possibility that a biblical text is produced by humans and need not provide an entire picture of the origins of the world is emphasized again at the bottom of the page,

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where the text juxtaposes the exclamation "Just a minute! Evolution—what's that?" with a picture of Darwin and a quotation: "My idea is that all forms of life have developed from simple living cells over millions of years."

Just as the title of the text emphasizes the social rather than transcendent aspect of religion in its title—referring to the notion of community—so the Fall of Adam and Eve is presented as "a breakdown in relationships," thereby depicting it in terms sufficiently generalized and humanly recognizable so as not to exclude non-Christians. Later, God as Creator is presented as a parent with worries over his children, while Genesis is said to present "an account of the beginning of things" (p. 69)—not, we notice, *the* account. Elsewhere in the text, the pupil learns, almost like an anthropologist, the beliefs and practices of the major world religions, juxtaposed and therefore in a sense made equivalent in a single course.

The outcome of this approach is often a graduate who values tolerance of opinion on the subject of evolution. For instance, a non-random sample of 20 British secondary school graduates was asked in a university class run by one of the authors to read a selection of different origin stories and then to comment on them in light of the theory of evolution. The students were enrolled in their first year in an undergraduate degree in biological and cultural anthropology. Far from wanting to argue vociferously in favor of evolution, this group demonstrated only a weak adherence to its precepts. Most said that different beliefs about origins should be tolerated. Several doubted the correctness of natural selection, but all passed the final examination on evolutionary theory held several weeks later. As Demastes et al. (1995) note, lack of agreement with evolutionary thinking does not prevent students in a biology class for non-majors from using "scientific conceptions" when required. The students felt that the inclusion of RE classes along with biology at the secondary school level promoted their tolerance of differing beliefs. They also expressed the opinion that the intensity of debate between creationism and evolution in the U.S. results from Americans' being a less tolerant people than the British.

In the light of this minor example, it is worth remarking that the diversity and size of the American university system have encouraged the development of hundreds of independent institutions of evangelical character which have few counterparts in Britain (Bebbington, 1994:374). As a consequence, a high proportion of American evangelicals move from school to college and graduate without having directly to encounter different views and faiths. In Britain, by way of contrast, Christian students at virtually all universities are exposed to a variety of religious perspectives. Scientists with a Christian organization called the Inter-Varsity Fellowship have actually led the way in endorsing evolution (Bebbington, 1994:374).

The Future

The British cultural landscape seems likely to include (and perhaps thereby to defuse) minority views considered respectable, while filtering out those considered extreme. The U.S. system is more oriented toward encouraging well-coordinated and aggressive forms of activism, profiting from the adversarial style of the courts in attempting to make their cases. The nature of political and legal decision-making in Britain has not encouraged the coordination and streamlining of a creationist movement that has been fragmented and diffuse in its beliefs and aims. In the U.S., however, politically and legally disputed questions like school prayer and creationist education have not just prompted debates over meaning and ultimate reality but also become tests of the influence that evangelicals can exert on the public sphere—flag-waving expressions of their ability to appropriate mainstream prac-

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tices in the name of God (Woodrum and Hoban, 1992:31).

Although we have argued that creationism is simply not a widely debated issue in Britain, a number of points in this paper have implied that possibilities for change in the future do exist. Increases in the deregulation of the media would help the creationists attempt to spread their message to as wide an audience as possible. If conservative Christianity manages to consolidate its position in opposition to liberalizing tendencies—particularly if reinforced by support from evangelicals abroad—then the grasss roots support for the widespread dissemination for creationist views could grow. As Davie (1994:70) has noted, an aspect of British evangelicalism in recent years has indeed been its gradual move toward corporate, social and potentially political activity rather than a more personal, quietistic orientation to the world.

Over the next few years, regional autonomy might well be gained in some form by the countries making up the U.K. Given such a development, Northern Ireland could provide a fertile ground for anti-evolutionist tendencies given its relatively high levels of religious activity compared to the rest of Britain. Furthermore, increased religious pluralism in Britain might ironically aid the evangelical cause by placing minority rights at the top of legislative and political agendas. The religious center of the country seems to be caving in, but this is not to say that its margins—including those occupied by creationists—are not maintaining themselves or in some respects becoming ever stronger.

Notes

1. A chapter in Wills's (1990) recent survey of religion and politics in America is actually entitled "Refighting Scopes."

2. It should not of course be assumed that Britain, or more accurately the U.K., is a homogeneous region. Levels of belief and practice tend to be higher in Northern Ireland, for instance, while in Scotland the Presbyterian rather than the Anglican Church represents the established faith. Wales, Scotland and Northern Ireland tend to be more Protestant than England (cf. Davie, 1994:94). In addition, Scotland's educational system is partially autonomous from the rest of the U.K. However, this paper examines the broad tendencies that can clearly be observed in the nation as a whole.

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Are Polonium (^{210}Po) Halos In Coalified Wood Evidence For The Noachian Flood?

Lorence G. Collins

Robert Gentry is a physicist who has attempted to find scientific support for the interpretation that the world-wide Noachian Flood actually occurred as reported in the book of Genesis in the Bible. His ideas are presented in a book, *Creation's Tiny Mystery*, where he suggests (pp. 51- 62) that elliptical and dual ^{210}Po halos in coalified wood from uranium deposits in Triassic, Jurassic, and Eocene rocks of the Colorado Plateau are evidence for a young age for the creation of coal as well as for the age of the Noachian Flood (Gentry, 1988). In the following sections I show that the ^{210}Po halos in coalified wood can also be explained by natural processes without relying on miracles or supernatural events such as the Flood.

Gentry's Hypothesis

In his description of the coalified wood fragments that occur in Triassic, Jurassic, and Eocene formations of the Colorado Plateau, Gentry claims that the wood came from trees that were growing immediately prior to the Flood (Gentry, 1988). This wood consists of both compressed and uncompressed material, can be black or brown, and contains original pithy cores that may or may not contain siliceous, calcitic, or dolomitic fillings. Some coalified fragments are still flexible when first collected but become brittle when dried. Gentry cites the flexibility as evidence for rapid deposition during the Noachian Flood. He believes that the sediments in which these wood fragments are found do not have natural origins that result from processes involved in *geological uniformitarianism,* but result from supernaturally induced, catastrophic events associated with a world-wide flood. Part of his argument is that the fossils found in these rocks provide evidence for rapid burial.

Gentry found ^{210}Po halos in the coalified wood but not any ^{214}Po or ^{218}Po halos. The Po halos are dark spheres in the wood where the wood has been damaged by alpha-particles (helium nuclei) that were emitted from radioactive polonium atoms as they decayed to atoms of lower atomic number. The radius of damage in the wood is different for each isotope of polonium, and the number of concentric spheres depends on which isotope is the starting point for the decay sequence. Three concentric spheres occur where ^{218}Po atoms decay to ^{214}Po, then to ^{210}Po, and finally to ^{206}Pb (lead). Two spheres occur where ^{214}Po decays to ^{210}Po and then to lead, and one sphere occurs where only ^{210}Po is present and decays to lead. In the coalified wood of Triassic and Jurassic age the ^{210}Po halos are a special case of dual halos in which former spherical halos are now elliptical (flattened) with relatively-dense radiation damage enclosed by outer spherical halos of nearly the same radius and having less dense radiation damage.

In coalified wood of Eocene age, only the elliptical halos were found, but Gentry believes that inadequate sampling may account for the absence of dual halos. On the basis

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of the elliptical shapes Gentry suggests that the halos all originated at about the same time, in agreement with the flood-related scenario. Gentry notes that the halo centers are composed of lead and selenium. He uses this relationship to suggest that the spherical halos result from the beta decay of radioactive ^{210}Pb, twenty years later following compaction of the Flood deposits. The isotope ^{210}Pb is a possible daughter product of ^{214}Po, has a half-life of 22 years, and decays by loss of a beta particle (an electron) to form ^{210}Po, which then eventually decays to produce the ^{210}Po halo. He believes that radiometric dates of 80 million to 55 million years ago, which have been assigned by Stieff et al. (1953) to some of the Colorado Plateau formations where the coalified wood specimens are found, are spurious because of misplaced confidence in the *uniformitarian principle* of constant decay rates.

The basic ingredients of Gentry's hypothesis are the following: (1) water, (2) uprooted trees as the source of the logs and smaller wood fragments, (3) a rich uranium concentration near the wood, and (4) a compression event occurring after the uranium solution invaded the wood, but prior to its becoming coalified (Gentry, 1988, p. 56). Because a rich uranium source is needed to supply the daughter ^{210}Pb isotopes that eventually produce the ^{210}Po halos, Gentry believes that a natural origin of these halos is improbable on the basis that a *uniformitarian* explanation would require three different periods of introduction of uranium-bearing water. In that case, he argues that the first event would have to have occurred in Triassic rocks, followed 10 million years later in the Jurassic rocks, and then 50 million years later in the Eocene rocks. All these events would also have to occur *prior* to coalification.

He believes that these great lengths of time are unlikely on the basis that all the wood that contains the elliptical, secondary ^{210}Po halos would have had to be in the same gel-like condition when infiltrated by uranium solutions. He argues that since it is not possible to maintain a gel-like condition through millions of years of time, the wood fragments and logs *must* have been buried quickly during the Flood and that soon after, the formations containing this wood were penetrated by the uranium-bearing fluids before the sediments were compacted. Furthermore, he believes that all halo-creating events had to be nearly simultaneous without separate compactions of the wood and that millions of years of time between separate events would have turned Triassic wood into coal before the Eocene layer was deposited. Finally, Gentry notes that some uranium-to-lead ratios have been found in various Colorado formations that indicate ages of several thousand years instead of millions of years and that some laboratory experiments show that wood can be coalified in a year or less or even just a few days. He uses these data to support his hypothesis for a young age of the coalified wood and claims its source as the Noachian Flood deposits.

Response to Gentry's Hypothesis

My response to Gentry's hypothesis and arguments is divided into three parts: (1) the geologic setting, (2) age-dating methods, and (3) the formation of the Po halos.

1. The geologic setting.

The formations in the Colorado Plateau which contain the Po-halo-bearing petrified tree logs are primarily sandstones and conglomerates that were deposited in former stream channels that have eroded into underlying flood-plain muds (shales). During modern-day floods, trees become undercut along river banks and are washed into the rapidly flowing flood waters. Somewhere, farther down stream, the heavy base of an uprooted tree trunk

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lodges in the bank, and the tip of the tree swings around like a weather vane to point down stream. Because of the way in which the trees were deposited in the flood waters, geologists from the U.S. Geological Survey in the 1940s looked for these logs and determined their orientations so that channel directions could be estimated. In this way it was possible to predict the locations of hidden uranium concentrations that occur along the buried channel that projected into the exposed cliff. Similar flooding of rivers could have occurred in Triassic, Jurassic, and Eocene times so that when uprooted trees were buried in river sands and muds, the wood later became the deposition sites for uranium introduced by fluids from an outside source.

Certainly, the locations of the petrified wood in stream channels support rapid (catastrophic) deposition for the sands and gravels that contain the coalified logs. But these occurrences are not evidence for a world-wide flood. In spite of Gentry's wish to set aside *uniformitarianism*, his catastrophic Noachian Flood model has to be consistent with a one-year-long flood that deposited the formations that enclose the wood fragments in the Colorado Plateau. For example, Gentry's model must also explain the larger picture in the Plateau rocks of the associated giant, wind-blown sand dunes of the lower-Jurassic Navajo Formation, the presence of both marine limestones and non-marine red beds, and the occurrence of gypsum beds in the Triassic Moenkopi Formation which require arid climates, evaporation, and disappearance of water in order to crystallize the gypsum. Gentry cannot choose only data that support his Flood hypothesis and ignore data that do not, and still make his model for the origin of the coalified wood and the associated Po halos convincing.

2. Age-dating methods.

In determining the young age of the earth, Gentry apparently uses the hypothesis of Archbishop Ussher of the Irish Protestant Church who assumed that the Bible contains a complete record of the world's history. Ussher added up all the genealogies and asserted that the earth was formed on October 24, 4004 B.C.E. (Brice, 1982). Accepting an age estimate of about 6,000 years for the earth, Gentry suggests that isotopic methods for age dating are not reliable. However, reliability for the ^{14}C-isotopic age-dating method, for example, is determined by comparing isotopic ^{14}C-ages with ages obtained from tree rings (dendrochronology). Because trees in temperate areas add one growth layer each year and because the width of a growth ring is a function of climatic conditions, ring patterns establish ages of trees from place to place.

On that basis, by describing and counting rings in living and dead bristle-cone pines in the Panamint Range of eastern California, dendrochronologists have assembled a master tree-ring template for a time span of 8,200 years (Fritts, 1976; Larsen and Birkeland, 1982). By comparing ^{14}C-dates of the wood with bristle-cone pine tree-ring dates or with historic dates of old cultures from which wood fragments in tombs have been obtained, scientists can check the ^{14}C-dates for accuracy. Systematic errors have been discovered for young ages as well as old ages, and some of these errors occur because of the burning of fossil fuels which changes the carbon isotope contents of the atmosphere and because of certain effects of ^{14}C production in the atmosphere during cyclic sunspot activities (Faure, 1977). Knowledge of the existence and estimated size of these errors allows scientists to make corrections of ^{14}C-dates. For ages older than 2,100 years, however, the errors are in the direction of making the ^{14}C-dates *younger* than the actual ages—not *older* as Gentry would claim.

On the basis of ^{14}C-studies of the bristle-cone pines, dendrochronologists have also found that the time span of 8,200 years is followed by a 1,000-year gap, because of missing

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trees, and then by older trees that give ages of 9,200 to 10,000 years. Therefore, on the basis of the above studies, the 8,200 years recorded in the bristle-cone pine tree rings, alone, make the Earth considerably older than Ussher's estimate of 6,000 years.

This discussion of ^{14}C-dating of bristle-cone pines in California is applicable to the ^{14}C- dating of coalified Douglas fir logs buried in glacial till near Two Creeks, Wisconsin. These logs appear almost as fresh as any modern tree that died and lay exposed to the weather for a few years. The wood and cones are both brown and black and locally partially carbonized. As the last glacial period came to a close, a forest at the margin of the retreating continental ice mass was buried in glacial till when the ice made a brief re-advance. The clay in the till kept oxygen from reaching the wood and preserved the logs until erosion exposed them. On the basis of ^{14}C-dating methods, these logs are 10,000 years in age—a value that is well within the ^{14}C accuracy and one that is verified by the dendrochronology and ^{14}C-dating of the bristle-cone pines in California.

Now, if Gentry's claim is correct that the brown and black coalified wood in the uranium bearing formations in the Colorado Plateau was buried 6,000 to 10,000 years ago during the Noachian Flood, then the Plateau wood fragments should also give verifiable ^{14}C age estimates in this age range. None of them does because they are much too old. Because the half-life of ^{14}C is so short (5,730 years), after a time of 50,000 years, essentially all ^{14}C is gone, so all the former ^{14}C in wood fragments in the Colorado Plateau has long since decayed and disappeared in rocks having ages of millions of years (Faure, 1977).

Gentry further tries to discredit dating methods when he reports ages of 80 to 55 million years for the age of formations that contain the coalified fragments in the Colorado Plateau. Because we date the Triassic from 230 to 180 million years ago and the Jurassic from 180 to 135 million years, how can a radiometric date of 80 to 55 million years ago be correct? There is no error in age determination here because the range of 80 to 55 million years represents the range of time in which the uranium-bearing fluids were introduced in multiple events into the older Triassic and Jurassic strata containing the coalified wood—not the age of the formations that host the uranium.

Moreover, Gentry's final point that some uranium deposits give ages of a few thousand years, which he suggested lends support for the Flood model, is not proof of the Flood model, either. In some places the original uranium ore deposits, now exposed by erosion at the surface, have been remobilized by hydrous fluids, so that some of the uranium was separated from its daughter decay-products and deposited in new sites. Every time this happens, the radiological "clock" for this uranium source is reset to produce new associated daughter products whose ratios with the parent uranium indicate the young ages of a few thousand years. Furthermore, Gentry has no justification for using those radiogenic young ages that fit his theory and ignoring data for old ages that do not. Gentry either trusts the isotopic age-dating methods, properly used, or he does not; he cannot have it both ways.

3. The formation of the Po halos.

The association of polonium with uranium concentrations is logical because ^{218}Po, ^{214}Po, and ^{210}Po are the final three daughter products in the uranium (^{238}U) decay scheme before the production of the stable lead isotope ^{206}Pb. The location of ^{210}Po halos surrounding nuclei of selenium and lead is also logical because selenium and lead commonly accompany uranium in hydrous fluids from whatever source these elements originated. The joint deposition of polonium with lead and selenium in the same favorable place is logical because all three elements have ions of +4 charge, and, therefore, they would precipitate in

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similar sites and in sites separate from uranium whose chemical properties and atomic size are different.

The formation of only ^{210}Po halos around the lead and selenium nuclei can be explained based on the half-lives of the different isotopes. The half-life of ^{210}Po is 138 days and of ^{210}Pb 22 years compared to 3.05 minutes for ^{218}Po and micro-seconds for ^{214}Po. The existence of only ^{210}Po halos is expected if the uranium-bearing fluids traveled considerable distances before arriving at their final deposition sites. A long period of travel time from this distant source would permit the decay of polonium isotopes having short half-lives, so that most of the short-lived isotopes would disappear before they arrived at the formations that contain the wood fragments. Only the ^{210}Po or ^{210}Pb isotopes would remain, either of which eventually would generate the ^{210}Po halos in the coalified wood.

There are no uranium-, lead-, selenium-, and polonium-bearing rocks locally in the sedimentary stratigraphic column of the Colorado Plateau that would provide the uranium-bearing fluids. Therefore, a deep, distant source is required. Although the uranium source is unknown, fluids carrying the uranium and polonium could have accompanied volcanism that occurred during the 80 to 55 million year interval. Because the time interval of 80 to 55 million years for the uranium deposition overlaps with the Eocene (60 to 35 million years ago), rocks of Eocene age can contain the ^{210}Po halos and uranium concentrations, but younger rocks do not.

One final argument against these Po halos as evidence for a recent age of the supposed Noachian Flood deposits can be made by reviewing the glacial history that led to the burial of the afore-mentioned Douglas fir logs under glacial till at Two Creeks, Wisconsin. The glacial deposits in the U. S. formed when thick sheets of ice covered Canada to an estimated *average* depth of 5,000 meters. After each glacial period, the ice cap melted and essentially disappeared before re-forming and advancing again. In the geologic record, here in North America and Europe, there are four separate glacial tills, topped by weathered soil-horizons and containing wind-blown loess between them. This sort of formation indicates at least four major glacial periods.

Moreover, because the glacial deposits rest on sedimentary rock containing fossils, then Gentry would argue that the glacial ages must have been after the biblical Noachian Flood. Based on the volumes of ice and rates of snowfall necessary to transfer water from the oceans to the continents to produce the four ice caps in the 6,000 years (or less), one can estimate the climatic changes that the planet must have endured during this time. On the basis of estimates, if these glacial and melting histories are to be condensed into 6,000 years, descendants of Noah would have had to endure winters with greater than 10-meter snowfalls per year, followed by blow-torch climates in which the ice melted prior to each of the next ice ages. Thus, if we are to believe that the recent ice ages were limited to such a short time interval, we would have to find scarcely bearable climatic conditions for Noah's descendants—conditions for which there is no corroborating physical evidence.

In other parts of the world the picture is even more complicated. Other glacial and melting histories elsewhere show thick glacial deposits are interlayered with fossil-bearing sediments. For all these fossils to have been laid down after the flood would mean arguing that these glacial and interglacial deposits formed during the one-year Noachian Flood and prior to the end of the storm—something that seems quite unfathomable.

The sum of these arguments from geology, physics, and paleontology must cast further doubt on the proposed short interval of time in which Gentry proposes that the elliptical-spherical dual ^{210}Po halos were formed in the geologic formations of the Colorado Plateau.

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Conclusion

On the basis of the arguments in the above three sections, other explanations are possible for the dual ^{210}Po halos in coalified wood than those proposed by Gentry, and these explanations utilize natural causes rather than miracles. Additional arguments against other hypotheses presented by Gentry (1988) regarding the age and origin of the Earth are presented in Hunt et al. (1992) and Collins (1988).

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[Additional information about polonium halos is available from the author at http://www.csun.edu/~ucgeo005]

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Commentary:

"Darwinism: Science or Philosophy?" Edited by Jon Buell and Virginia Hearn, 1994. Foundation for Thought and Ethics, Richardson, Texas, 229 p. $37.50.

Review Essay by Neil A. Wells, Geology Department, Kent State University

This book presents the proceedings of a symposium opened in 1992 by University of California (Berkeley) law professor Phillip Johnson to discuss the proposition, "Darwinism and neodarwinism as generally held in our society carry with them an *a priori* commitment to metaphysical naturalism, which is essential to make a convincing case on their behalf" (p. 1). Johnson's interest stems from his 1991 book *Darwin On Trial* in which he presented his case against Darwinian evolution. In Johnson's view, the naturalist or scientific view must have an explanation for the origin and diversification of life in order to maintain dominance over religious worldviews, but the best that scientists can do is the pitiful and shaky idea of evolution by natural selection. He claims that, in the absence of data, scientists are forced to defend Darwinism at all costs, no matter to what sorts of misdirection, bluff, and subterfuge they must stoop in order to protect their weakest point. Johnson argued in 1990, "victory in the creation-evolution dispute therefore belongs to the party with the cultural authority to establish the ground rules that govern the discourse. If creation is admitted as a serious possibility, Darwinism cannot win, and if it is excluded *a priori*, Darwinism cannot lose" (cited by Shapiro, pp. 166-167).

In Johnson's view (p. 47) the stakes are high—whether science or religion will control public education and government support. Thus in order to knock some of the philosophical justification out from under evolution, to discredit it, and to force some room for God before He gets crowded out, Johnson is asking in the new book whether evolution by natural selection is the only logical conclusion, if you don't start out by excluding God and purposiveness from consideration, and if you aren't fighting to save the scientific worldview.

To the editors' credit, the new book is attractive and well produced with very few technical errors, except for several misspellings and a citation error in the paper by David Wilcox. Furthermore, in strict contrast to the rather one-sided case prosecuted by Johnson (1991), this book is very fair. It matches two opposing teams of five people each, plus a fence-sitting philosopher. Without editorializing or bias, the editors let the authors have their say in papers presented, replies from the other camp, and, in some cases, further rejoinders. In fact, it has a nice tone of "give and take," mostly polite, but with a few peppery gems such as Shapiro's dismissal of Wilcox's citations as "pervasively irrelevant." Both

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teams included science PhDs; there were four biologists and a biochemist *for* evolution matched by a chemist, a geneticist, a mathematician, a lawyer, and a philosopher against. Unfortunately, no geologists or paleontologists were involved, so paleontology was left to lawyer Phillip Johnson, mathematician William Dembski, and ecologist Leslie Johnson, with kudos only to the last.

Overall, the book is a readable primer on scientific philosophy, and it provides a relatively sophisticated and invigorating philosophical challenge. It scores four legitimate hits. First, evolutionists, being human, are indeed prone to slip into beliefs, advocacy, preferences, opinions, poor phraseology, and other less-than-ideally scientific thought processes. Overfamiliarity with a complex theory can and does breed mental short-cuts that can hide anomalies and alternative explanation. Second, scientists (not unlike creationists!) do rely too heavily on illustrating arguments and logic with cliched metaphors, which is problematic because even armadas of metaphors tend to pass quietly in the night without engaging battle. Third, some evolutionists are indeed quick to insulate themselves in creation-evolution confrontations by claiming that religion and science fall into separate spheres, while simultaneously eagerly proselytizing in other fora for a large and uncaring universe without purpose or morality other than what humans create for themselves. Fourth, Phillip Johnson (pp. 11-12) points out cogently (and correctly) that we would question the objectivity of any physicist who said that relativity "has a great past: let us work to see that it has an even greater future," although no scientists complained when a zoologist recently used those words about Darwinism (Ruse, 1982).

On the evolutionist side, geneticist Morrow provides an interesting review of how our understanding of the immune system informs and is informed by evolutionary theory. (Readers should also be aware of related work by Williams and Nesse [1991; Nesse and Williams, 1994] on the advances, including unexpected ones, made possible by applying Darwinian reasoning to medicine.) Evolutionists will also appreciate Leslie Johnson's arguments about the sparsity of the fossil record, suggesting in part that perhaps only 1 in 7,000 extinct species becomes known. This is an important point, because we often hear "all the work and all the fossils collected by now means that we should know all the transitions." People who say this do not seem to have any concept of how few animals and species become fossils, how fossils tend to represent extremely small pockets of space and time, and how hard it can be to find informative fossils.

This point could be illustrated by calculating how many rabbits and squirrels must have died in the reader's garden or neighborhood park over the last 2,000 years. For my *own* garden, there should be 16,000 skeletons if one pair of rabbits and one pair of squirrels each produce only four young per year and the population remains the same size over the long term. However, there simply is no accumulation of preserved remains in my garden—every single one has been destroyed to dust. Worse than the improbability of the preservation of any individual is the problem that the fossil record is profoundly unrepresentative of the biota in any period. Most high-level taxa presumably arise as very small populations that show exceptional deviations from the parent species' norm, and most modern "atypical" populations live in small areas, like islands, mountain tops, or crater lakes. Of all the livable habitats present during any geological period, most are established in areas of erosion and only a few of the rare depositional areas will actually preserve any fossils. By today, nearly

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all of those deposits will either still be buried or will already have been eroded, and of the tiny portion at the modern surface, most will be inaccessible, overgrown, flat, deeply weathered, or otherwise not propitious for finding the fossils. Thus, whole floras and faunas may escape discovery.

We can also appreciate the unlikelihood that animals will be preserved by looking at how many of our fossils are just barely known to science. For example, dinosaur fossils tend to be big, actively sought, and hard to miss. Whole groups could easily escape detection. Weishampel and others (1990) compiled a list of all dinosaur species and fossils that indicates we almost missed knowing perhaps 8 of the 41-43 known families of dinosaurs. We have only one bone for Blikanasauridae, one jaw each for the two species in Caenagnathidae, and a partial skeleton and some bits and pieces for the three species in Elmisauridae. Neither Harpymimidae nor Garudimimidae are known from more than a single individual, and the sole species of Anchisauridae is not much better represented. Three other families (Huayangosauridae, Yunnanosauridae, and Massospondylidae) are also represented by only one species each, although by more numerous and complete individuals. However, the first two are known only from one area which might easily be overlooked. In other words, our knowledge of perhaps nearly 20% of the known family-level diversity of dinosaurs must be considered entirely fortuitous.

At the species level, the news is even worse. Of about 440 dinosaur species (including some as-yet unnamed ones but excluding many dubious names), around 115 are known from what appear to be reasonably good, complete fossils, or better, but perhaps nearly 250 are known from extremely fragmentary and incomplete fossils. In other words over half are only a few bones from being completely unknown.

The anti-evolutionists in the Buell and Hearn book, for once, do not serve up a standard creationist rehash. They do not push for a young earth or "flood geology" and are refreshingly free of dishonesty and deliberate sophistry. However, this does not mean that their essays are free from serious problems. Mathematician/philosopher Dembski argues that scientific hypotheses are logically incomplete because they exclude God. This might sound promising for religionists, but it quickly leads to a series of classic dead-ends. Saying "God created it" is fine as a statement of belief, but it is powerless as a statement of process or explanation, it leads to no predictions or tests, and it opens the question of where God came from before the creation. The same waters have already been fished out by Moreland (1989), who ended up having to make the unusual claim that "God is not necessarily a religious concept".

Although the anti-evolutionists here are not bad at distinguishing evolution (development of new species from pre-existing ones) from natural selection (a process for evolution), they do conflate the origin of life with the theory of evolution, and they treat natural selection as the only mechanism for evolution, excluding any suggestion of additional mechanisms as an ad hoc explanation that merely belies underlying conceptual weaknesses. This is a straw man. Few, if any, biologists would deny a role for genetic drift and founder effects, and many would agree that room remains for heterochrony, chromosomal recombination, jiggering around with homeoboxes, and who knows what else to change our understanding of large-scale, co-adapted innovation at high taxonomic levels.

Phillip Johnson accepts differentiation of mainland species on islands, but he appar-

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ently can't make the small jump to evolution's similarly filling whole ecosystems from a few immigrants, such as on Madagascar and Australia, or from a few survivors, such as after the Permian and Cretaceous extinctions. (More than 95% of all species went extinct at the end of the Permian, and all Mesozoic ammonites seem to have come from just two surviving genera.) Johnson and others dismiss the results of artificial selection (because dog breeders always end up with interfertile dogs), rather than seeing this as evidence for the vast potential for change that is present in most species. The complaint that breeders can exhaust available possibilities says to me merely that all combinations of *existing* mutations *can* become exploited (by humans or by nature) and that more time is needed for additional non-deleterious mutations to happen. The anti-evolutionists also fail to see that subspecies, clines, and ring species are sequential (and reversible) steps on the way to splitting a species into two and that such a normal and gradual divergence can and does produce reproductive isolation mechanisms in time-frames that are *geologically* very short, but long in human terms.

Perhaps the most egregious error in this book is chemist Michael Behe's stressing the rarity, complexity, and improbability of any particular workable protein without understanding the positive role of cumulative selection. Behe mangles and misrepresents Richard Dawkins's metaphor of monkeys typing sentences, mostly by using goal-directed evolution and calculations for an "all at once" production of proteins. There are several levels to this problem, each with different answers, and it is worth noting that Dawkins specifically refuted Behe's arguments back in 1986, on pp. 49-50 of *The Blind Watchmaker*.

Behe stresses work by Reidhaar-Olson and Sauer (1990) regarding substitutability of amino acids at different sites in a protein. They showed that substitutability varied from 0-15 of the 20, therefore, Behe says that for a string of three positions that accepts 4 of 20 amino acids in the first position, 10 of 20 in the second and 1 of 20 in the third, only 40 of 8,000 random combinations would work. Expanded to a regular-size protein, this probability shrinks to around 1 in 10^{65}. However, this estimate assumes that the goal is *that* particular protein, whereas the problem of the creation of the first foldable protein is the creation of any foldable protein, not a specific one. Reidhaar-Olson and Sauer (1990) in fact show that considerable variation in "spelling" is permissible; if a 400-amino acid protein allowed an average of 3 substitutions per site, then single substitutions alone could "spell" that protein 1,200 different ways.

Dawkins also provided a neat conceptual suggestion that might obviate this entire line of concern. He noted that an arch is highly stable but cannot be built by adding stones one by one, although it can be done easily if you build it within a supporting framework or scaffold and then take the supports away. Dawkins discussed clearly how clays might provide that support for proteins by serving as a template. Julg (1989) showed how inherent asymmetries in kaolinite clay particles might account for the surprising natural predominance of L-form proteins over D-forms, if kaolinite was used as a template for the first proteins.

Behe's failure to understand cumulative selection is even more critical. Let me propose the following unrealistic numbers for the purpose of illustrating the math; suppose bacterium A to bacterium B requires two beneficial mutations, each with a likelihood of one in ten million. Behe would say that both mutations had to hit independently and together (in

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the same bacterium), giving a 1 in 10^{14} chance (10^{-7} x 10^{-7}). However, if the two were allowed to be sequential, then in ten generations of a million bacteria each, the first mutation should arise, whereupon selection could quickly replace the entire population with a million bacteria of the improved type for the next round of chance mutation, which should happen within another ten generations. Overall, this could involve as few as 20 million bacteria (10^7 + 10^7, not including the generations of unimproved bacteria during their replacement). If the mutations can happen independently and do not have to happen in sequence, then each should occur once in the first 10 million bacteria, and both will spread quickly in the population until they meet in one offspring. Thus cumulative selection offers an extremely powerful reduction in improbability. In many ways, evolution is less like the probabilities of flipping coins and compiling poker hands and more like the way science progresses by the origination, "cultural selection," spread, and continuous community-wide refinement of new ideas.

Possibly taking his cue from Johnson (1991:84,178), Behe also makes an horrendous hash of whale evolution. He starts by identifying the archaeocete (primitive whale) *Basilosaurus isis* as a normal whale with "throwback" dwarf legs and with no significant similarities to mesonychid condylarths (the land animals from which whales are thought to have evolved, according to Van Valen, 1966). Although *Basilosaurus* was indeed fully marine, Behe ignores its condylarth-like teeth and skull and the other primitive features described by Gingerich and others (1990).

The rest of his discussion dwells on the "glaringly obvious" lack of transitional forms between mesonychid condylarths and *Basilosaurus*. Van Valen's original proposal implicitly required the eventual discovery of transitional forms (contrary to the argument by some creationists that paleontology and evolution are not good science because they cannot make predictions or pose testable hypotheses), so Behe's demand is legitimate. However, it is marred somewhat by his ignoring *Pakicetus*, a slightly earlier and even more primitive archaeocete than *Basilosaurus*, that was described by Gingerich and others in 1983. *Pakicetus* is principally known from its skull and teeth, but its ears strongly suggest insufficient adaptations for a fully aquatic lifestyle, so its discoverers implied that it should be part of a group of early legged whales.

Additional transitional whales have since been found in rocks representing a relatively few million years in the Eocene of India, Pakistan, and Egypt (see Blackburn, 1995, and Gingerich and others, 1995). Thewissen et al. (1994) found the archaeocete *Ambulocetus natans*, which had long strong hind legs and probably swam with up-and-down feet-and-spine motions like sea otters (and, to a lesser degree, polar bears), and perhaps moved on land like sea lions. Gingerich et al. (1995) noted that *Dalanistes* and *Remingtonocetus*, two archaeocetes in an early side-branch called the Remingtonocetid family, combine long hind limbs with a robust and rigid, fused sacrum (the vertebrae that link the two halves of the pelvic girdle), implying that their legs could support their weight on land. They also had relatively long and mobile necks, unlike modern whales but as befits a creature that needs to swing its head around to look at the ground, while at the same time featuring long and slender crocodile-like fish-catching jaws. *Remingtonocetus* fossils (referred to as *Indocetus* in Gingerich and others, 1994, and Gingerich, 1994) had ears adapted for underwater use and large tail vertebrae that suggested use of the tail for propulsion.

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More recently, Thewissen and others (1996) compared ^{18}Oxygen-^{16}Oxygen isotopic ratios in living freshwater cetaceans, modern marine cetaceans, and some Eocene archaeocetes. The demonstrably marine *Indocetus* had isotopic ratios exactly like modern whales that live in the sea and drink sea water, but the presumed semi-terrestrial estuarine or riverine cetaceans *Pakicetus* and the very recently found *Nalacetus* clearly had ratios identical to modern cetaceans that live in rivers and ingest only fresh water. *Ambulocetus* was found in indisputably marine deposits, but it had a fully fresh water isotopic composition, so either it lived in fresh water as a juvenile (when its teeth formed) or it still needed to drink fresh water. This serves as independent evidence for the transition by whales from land and fresh water to the marine environment.

Gingerich and others (1995) also discussed some Middle Eocene protocetid archaeocetes that illustrate further adaptations to a fully aquatic lifestyle. *Rodhocetus kasrani* had backbone-pelvis-leg connections allowing it to support its body on its legs, but the vertebrae that *ought* to be fused to make up the sacrum in a terrestrial animal had become unfused, making the lower back more flexible for more efficient swimming (Gingerich and others, 1994, 1995). It also had several other specializations for whale-like swimming by up-and-down movement of a strongly muscled tail. The sacrum of *Protocetus*, another early whale, was reduced to just one vertebra and no longer had direct connection with the pelvic girdle. This means that its backbone had become even more flexible for swimming and its legs could no longer hold up its body via passive skeletal support (Gingerich and others, 1994). The sacrum of a third protocetid, called *Gaviacetus,* is not as well known, but indicates tail-powered swimming more similar to *Protocetus* than *Rodhocetus*. Among the more advanced basilosaurids, the fully marine *Prozeuglodon atrox* had dwarfed and disconnected but muscled and movable legs like *Basilosaurus* (perhaps using them to help grapple during mating), and its body and vertebrae suggest that it was closer than the bizarre *Basilosaurus* to the main line of descent to modern whales. In view of all these fossils, what more could rationally be desired to satisfy Behe's demand for intermediates between mesonychid condylarths and *Basilosaurus?*

Blackburn's 1995 discussion of anti-evolutionist missteps around transitional forms (including whales) suggests that the Behes, Johnsons, and Gishes of the world would appear to be satisfied only by human observation of something like a reptile evolving into something like a bird. It bears repeating that this is a silly expectation. Changes at high taxonomic levels are obviously very unlikely because higher taxa themselves are not very numerous. More importantly, if this change took more than a few steps, human psychology would never let us recognize it for what it is! The world has countless peculiar creatures that are quite different from their relatives, but we inherently think of them as dead-ends or oddities (or in our own case, as a perfect conclusion), and we seem incapable of viewing them as potential points of departure for whole new future groups. Without the benefit of arrival, we do not perceive the voyage.

Overall, a theme common to many of the anti-evolutionists in this book (one all too familiar to creationistwatchers) is that they insist that science has to demonstrate and understand perfectly the evolution of everything from the origin of life through every known specialization to the production of new phyla tomorrow; failing this, we must admit God's will as the preferred explanation. My personal view is that humans have only been doing

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science in earnest for about 200 years (only 5 to 7 academic generations), and I am absolutely flabbergasted that we have come as far as we have, so I'm willing to be patient regarding problems not yet solved. Just as anti-evolutionists keep emphasizing, world views can indeed limit what people see. However, this book suggests to me that the blinkers have been donned by the anti-evolutionists to keep from scaring themselves in the traffic, whereas scientists are still at work on an observation tower for the view they want of the world.

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Book Review

Race and Other Misadventures: Essays in Honor of Ashley Montagu in His Ninetieth Year.

Larry T. Reynolds and Leonard Lieberman, eds., 1996. General Hall, Dix Hills, NY, 424 pp. $69.95 hardcover

Reviewed by Jonathan Marks, Department of Anthropology, Yale University

The major liability of the theory of evolution is its historically close associations with racialism (the clustering of human populations into major units ostensibly equivalent to zoological subspecies) and racism (the evaluation of an individual's worth on the basis of group assignment). If anyone can be said to have addressed these issues profitably over the last century, and helped to clarify the nature and meaning of human microevolution, and thus to have unburdened modern biology from its largest problem, it is the subject of this festschrift, Ashley Montagu.

In a career spanning several academic generations, Montagu has been an active contributor to the primary literature, and popularizer in the secondary literature, of paleoanthropology, comparative anatomy, human genetics, psychology, and history of science. As a spokesman for the natural and social sciences, he could be seen debating hereditarian Richard Herrnstein on television about the genetics of aggression as manifested in the XYY syndrome a quarter-century before *The Bell Curve*. The only criticism one can offer of this volume is that it is nearly smothered by Montagu's own breadth and accomplishments. Thus, the book pays homage almost entirely to Montagu as a crusader against hereditarian and racist biology (11 essays), and secondarily as a critic of simplistic ideas about human nature (6 essays), a promoter of a non-sexist biology (3 essays), and a modern moral philosopher (2 essays).

The three most original historical contributions are Andrew Lyons's, assessment of Montagu's life and work (though unfortunately neglecting his outspoken role vis-à-vis Carleton Coon and his 1962 *The Origin of Races*); Elazar Barkan's discussion of the UNESCO statements on race (of which Montagu was in charge); and Christine Gailey's analysis of the construction of skin color as racial marker in 18th-century French writings about Melanesians.

Of more general interest to evolutionary biologists are Margaret Power's critique of the Gombe chimpanzee studies and their relevance for human nature, Gilbert Gottlieb on developmental biology, Fredric Weizmann et al. on the abuse of evolutionary biology in the racist pseudo-scientific writings of J. Philippe Rushton, and Harriet Lyons on the evolution of human sexuality.

The most noteworthy of the current-events papers is John Moore's essay "Is the Human Genome Diversity Project a Racist Enterprise?" Moore, an HGDP participant, breaks ranks and acknowledges the propriety of the criticisms that several of us have leveled against it. These criticisms are also reiterated in the timely and incisive essay by Alan Goodman and George Armelagos in "Race, Racism, and the New Physical Anthropology."

In sum, for those who teach about human evolutionary biology and its relation to contemporary science and society, this collection is a valuable resource, a compilation of thoughtful papers that ultimately does credit to the evolutionary polymath Ashley Montagu.

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Book Review

The Age of the Earth.
by G. Brent Dalrymple, 1991.
Stanford University Press,
Stanford, California, xviii + 476 pp. $.24.95

Reviewed by Frank Sonleitner, Department of Zoology, University of Oklahoma, Norman

The author describes in the preface how this book came about as a result of his contacts with creationism and creationists. The book does not deal with creationist arguments but explains how scientists have deduced the age of the earth. It is intended for people "with some modest background in science" and has a lexical difficulty on a par with a *Scientific American* article. To further aid the reader, technical terms are italicized and explained in a glossary. Dalrymple also provides citations to other books and review articles on the subject matter of each chapter, and an extensive list of references cited is included in the back of the book. The graphs are well done and the few photographs well chosen—although Figure 4.2 needs some indication of its scale.

This book should prove very useful to evolutionists. It clearly explains the basis of the various radiometric methods, most of which have inherent self-checking features, thus refuting the claims of creationists that they are based on untestable assumptions. The nine chapters include an introduction, discussion of early attempts at estimating the earth's age, how modern radiometric methods work, the ages of the earth's oldest rocks, moon rocks and meteorites, the lead isotope method of determining the earth's age, and other lines of evidence indicating the age of the universe. All of this information is concisely summarized in a final chapter on what is known and not known about the ages of the earth and the universe. C/E

[*Ed.* The Age of the Earth *is available from NCSE books. For information on ordering, call NCSE at (800) 290-6006.*]

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Book Review

Biology Through the Eyes of Faith. by Richard T. Wright, 1989. HarperCollins, New York, 288 pp. $12.00 paper

Reviewed by Andrew J. Petto, Wisconsin Teacher Enhancement Program in Biology, University of Wisconsin, Madison

> Which is true: creation or evolution? . . .Christians in biology are directly in the line of fire, and in this case it is a crossfire. We are challenged from one direction by fellow Christians, who often use this issue as a test of orthodoxy, and from the other direction by non-Christian friends and associates: How can you be a scientist and also believe in the Bible? (p. 70).

This is how Richard Wright has framed the central question of his book, *Biology Through the Eyes of Faith*, and it is an important one indeed. Readers familiar with NCSE's *Voices for Evolution* already know that many Christian denominations have considered this question and found that there is no impediment for believers in the study and practice of evolutionary sciences. Yet, the issue persists precisely as Wright lays it out here.

Wright is frank about his faith, so his discussions relating to biblical scripture and matters of faith may make readers who are unaccustomed to such language a little uncomfortable. It is extremely important, however, to read carefully and understand his use of the language of faith as it relates to his understanding of his professional role and moral obligations as a Christian and a biologist. In particular, it is important to understand the concept of "creational" law—and the two modes of operation of this creational law that Wright calls *structural* and *normative* law. The former is concerned with the "order and regularity" that we observe in the world around us. Structural law is what we describe and model when we speak of "natural" laws. Normative law relates to the "proper form and function" of this order—the way that it *ought* to be—and its violation is seen in the degradation of environments by humans' misuse of the earth's resources.

There are two other main themes to this book. The first is that of "worldview" (sic). Our readers may recognize this as a code word used in the battle against evolution in public education, however, Wright takes care to explain that world views are presuppositions we have about the makeup of our world. "Worldviews determine values, help us to interpret the world around us, and in general function as a guide to life" (p. 9). In *Biology Through the Eyes of Faith* Wright explains his Christian world view in the first chapter and lays out the presuppositions that he holds as a result. Then he goes on (throughout the book) to explain and demonstrate what this world view means for the study and practice of biology.

The second main theme is that of "stewardship." In the Christian world view (and under the conditions of "normative" law), Wright explains, it is proper to study the "how" of the world—the natural laws, the operations of biological principles, etc. However, stewardship requires that Christian biologists also bear moral responsibility for the use of nature's bounty. For Wright, this moral responsibility is the *essential* meaning of creational law that

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makes *Christian* scientists different. Much of the second half of the book is devoted to demonstrating this principle in the context of contemporary ecological problems.

What Wright has to say about the meaning of the Bible in general and of Genesis in particular is very important for our readers.

> My understanding of the structure of science indicates that ... biblical principles may play a legitimate role as framing principles, but ... are not data nor ... theories in the scientific sense. They may influence the way we do our science, but that is a very different matter from postulating that the Bible contains relevant scientific data—information that not only has status as a source of information for scientific theorizing, but because of the status of the Bible as God's word, possibly even takes precedence over data from the natural world (p. 65).

Wright is critical *both* of creationists who insist that biblical writings must take precedence over our observations *and* of scientists who deny that they operate out of a world view that similarly constrains their vision of the universe. He provides a good overview of both naturalistic and theistic world views that have shaped the sciences and the anti-evolutionary movements over the past 2 centuries. Then he poses the metacognitive challenge:

> A theistic worldview does not require any particular explanation of origins. The choice is a matter of scientific reasoning and sifting of evidence. Remove evolution from the naturalistic worldview assumptions that are usually tied to it and it no longer poses a serious threat to biblical faith. Remove the scientific creationist or instantaneous origins view from a worldview status and it faces examination as a model at the scientific level. What happens then? (p. 134).

The answer to that question, of course, is repeated many times over in *Voices for Evolution* and was very quickly settled in the last century by most major Christian churches—*then* we must accept evolution as the explanation for the diversity and history of life in the same way that we accept gravity as the explanation for why things fall when we drop them. That is the way the world works.

Finally, it is important to consider Wright's own answer to the dilemma posed in the quote that opened this review.

> For some reason, it never occurred to me to question whether science—and biology in particular—was a legitimate activity for a Christian. I am aware that science is regarded with suspicion in some Christian circles, and I know that biology in particular has a reputation for being far too familiar with evolution. However, I can look back and see that God used all sorts of circumstances to call me to a life of teaching and research in biology (p. 46).

This statement resonates for the many Christians who are also scientists—particularly in the biological sciences. Their faith is intimately bound up in their professional lives, not sequestered in some special corner. However, they are careful how and when they show it; it can be most unpleasant at the center of a crossfire.

For a thoughtful and considered account of what it means to be a Christian *and* a biologist, Wright's book is one of the best places to start. Although this edition was published in 1989, Wright is currently making arrangements for a second edition.

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Planet Ocean, a Story of Life, the Sea, and Dancing to the Fossil Record.

by Brad Matsen, Illustrated by Ray Troll, 1994. Ten Speed Press, Berkeley, California, 116 pp. $42 hardcover, $19 paper

Reviewed by Thor Henrich, Victoria, B.C.

From my recent light readings, I must recommend most highly to you the humorous, intelligent and perceptive book, *Planet Ocean, a Story of Life, the Sea, and Dancing to the Fossil Record*, written by Brad Matsen and illustrated by Ray Troll. Readers are probably already familiar with this zany cartoonist who combines realistic fish images with humans in odd but thoughtful combinations. You've seen his T-shirts: "Bass Ackwards," "Spawn till you die" and "The Fish are Calling." On a Sunday morning, October 1994, I visited the Burke Museum of Natural History in Seattle on the last day of a most successful exhibit of Troll's works from the book entitled *Planet Ocean, Dancing to the Fossil Record.* I was able to meet him and enjoy a breakfast with him and a few of his paleontologist friends who were discussing Alaskan fossils in a most knowledgeable manner. In a few short years, Troll's work has grown from a focus on fishing and humans to broader paleontological themes that appear in the lavishly colored scenes of this book. From accurately drawn lobe-fins crawling "Out of the Ooze and Born to Cruise" to plesiosauria flying over a midwestern rural roadway in a "Cretaceous Road Dream," Troll focuses our attention on the most interesting features and enigmas of evolution in the seas of central North America.

If Troll is an interesting and refreshing thinker then the author of the book, Brad Matsen, is his perfect literary companion. Both are confessed, fallen Catholics, bearded "hippies" who more or less followed the ancient western edge of North America. They traveled southeast from Alaska to Kansas in a kind paleontological "Wizard of Oz" odyssey, visiting famous and unusual fossil sites along the way. Matsen perfectly emphasizes the salient features at the Burgess Shale, Royal Tyrrell Museum, Museum of the Rockies, Fossil Butte National Monument, Dinosaur National Monument, the Denver Museum of Natural History, and the Sternberg Memorial Museum.

Matsen has a thorough understanding of geological time, and starting with the Big Bang, he guides us through the major events in evolution through the subphylum Vertebrata. Nor is Matsen afraid to take potshots at fundamentalists who seem intent on destroying modern science education in favor of their beliefs. If, like me, you are getting tired and bored of the plethora of books treating *T. rex* and company, but enjoy paleontology at the level of an intelligent layman, you will find *Planet Ocean* the perfect bedside companion. Its well-illustrated 133 pages includes a "Related Reading" section on topics in geology and plate tectonics, ichthyology, natural history, paleontology, and physics. The index is also quite detailed and useful. This book is current, bright, and fun, but not silly. It is worthy of every penny of its $42 and should be in every major library. C|E

[*Ed.* Planet Ocean *is available from NCSE books. For information on ordering, call NCSE at (800) 290-6006.*]

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Book Review

Goodbye Darwin: A Handbook for Young Adults by Art Cooper, Key Publishing Co., Port Huron, MI, 1995.

Reviewed by Sheldon F. Gottlieb, Department of Biological Sciences, University of South Alabama, Mobile.

It never ceases to amaze me how creationist literature is continually produced primarily designed to accomplish two specific purposes: 1) to prove that evolution could not and did not occur, i.e. that evolution is not science and, therefore, must not be taken seriously; and 2) that creation, as described in Genesis, is the only "scientifically" accurate depiction of origins. The entire antievolution enterprise would be amusing if there were not serious consequences for society. One of the latest of these creationist books is the 110-page soft-cover book *Goodbye Darwin: A Handbook for Young Adults*, which has undergone four printings since its original publication in 1994. The book is written in a breezy, relatively easy-to-read style, with each chapter except the last ending with the admonition "read on." At the end of Chapter 13, Cooper concludes: "As I close this book, I must utter a sad parting word to the originator of evolution. Goodbye, Darwin."

Cooper admits in the author's foreword: "This is not a science textbook. Make no mistake about that....Therefore, the purpose of this work is to provide young adults with a quick reference, a handbook of facts which challenge Darwin and his theory of evolution." I wish Cooper were equally honest about his discussion of "facts" that presumably discredit Darwin and disprove evolution. Yet, despite the author's claim about using newly discovered evidence with which to disprove Darwin, the book is replete with scientific errors and with references to the Christian Bible and the role of God. One looks in vain to find the "newly discovered evidence" that disproves Darwin. Cooper does request that readers keep their Bibles nearby for the last three chapters.

Cooper adopts the discredited "two-model" approach to evolution. The basis of this approach can be summed up by "If you are wrong, then I am right, and I do not have to prove that I am right." For example, on page 8 Cooper states: "Clearly, if the Earth did not evolve, we are left with the alternative option: Our world was created by God." Apparently Cooper dismissed Judge Overton's opinion in the 1982 *McLean v. Arkansas* decision in which the judge rejected the two-model system because of its philosophical fallaciousness.

Cooper is not above building straw men which, by their destruction, would demonstrate the alternative option. He also imputes base motives to educators while developing a theme of conspiracy against God on the part of educators. Of course, he does not substantiate the charges. On page 10 we learn "that Darwinism has become embedded in our colleges and universities as a part of an overall philosophy, the same as Marxism and many other popular 'isms.' Most science professors, in order to protect their jobs, did not want to rock the boat." Later, he continues, "[Evolution] can no longer be considered science, but a form of godless religion" (p. 11). "Darwinism could be classified as a cult....There is but one source of man's existence: God" (p. 12). "In time, all the communist (and socialist) countries have accepted the Theory of Evolution as a basic fact, even though it remained

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unproven. Darwin had removed God from nature, and communism endorsed this creed as part of its own belief. Today, the philosophy of communism is dying. Can Darwinism be far behind?" (p. 18).

For a person who claims to have been trained in "math, chemistry, and biology" (p.7) and is "an industrial chemist, fully degreed" (p. 11, yet we are never told specifically what degrees he has earned), Cooper demonstrates a marked misunderstanding of what constitutes a scientific theory: "principles or suggestions which could not be proven by existing facts" (p. 14). With a not-too-subtle legerdemain, Cooper suddenly equates scientific theory with scientific law; "the theory of evolution is NOT a proven law" (p. 11). Of course, no one ever claimed that evolution is a law.

Cooper is an advocate of a young earth. He does not personally endorse current views as to the age of the earth and when life started—he believes that the times are much shorter than scientists claim (p. 23 and Chapter 10). Despite his beliefs, Cooper, using the "old" age of the earth as approximately 4 billion years, claims that only 2.5 billion could have been available for life to develop. His times do not coincide with the fact that life is thought to have arisen approximately 3.5 billion years ago and that fossils have been found in rocks *older* than 2.5 billion years.

In Chapter 4, Cooper expends a lot of effort trying to reconcile the (Christian) biblical time frame of 7 days for creation with the Big Bang. Here are scientifically unsubstantiated statements mixed with religious beliefs. "Early on, the cosmos was formless, a murky soup of raging fluids and gases, boiling in total darkness, God's own intelligent direction took over at this point, causing the rampant energy to crunch down into little bundles called atoms....The only differences between Hubble's Big Bang Theory and Genesis One is a single item: Genesis claims that the source of power and direction came from God, while Hubble does not" (p. 25). Irrespective of whether the difference between Genesis (religion) and science is a single item or many items, Cooper fails to grasp that the mere introduction of a supernatural being into the discussion takes the subject out of the realm of science. He fails to realize that with the introduction of a god to explain creation, there is no longer available any hypothesis which can be scientifically tested, verified, or falsified. To postulate a god takes the question out of the realm of science into the world of the supernatural.

Realizing that there is a second basic difference between the Bible and Hubble—the time frame—Cooper spends considerable time and energy trying to explain a concept of time dilation based on Einsteinian concepts of the speed of light and concludes that "[n]o single measurement of time could be applied using our common units of days and years. In other words, those early events of creation were controlled by God....Only God knows the length of time that it took to create our Universe" (p. 27).

Chapter 5 is concerned with demonstrating that fossilization, genetics, mutations, and DNA prove that evolution could not occur. Cooper's description of fossilization (p. 33) is erroneous, and he compounds this error when he discusses botany and mutation. "In other words, plants cannot be made to mutate" (p. 33). He also falsely attributes the knowledge of the genetic code to Gregor Mendel; "He [Mendel] realized that this genetic code was very rigid and defied changes from outside forces" (p. 33).

Cooper's apparent ignorance of genetics is amply demonstrated in his DNA model (Figure 3, p. 62). He seems unaware that within a single chromosome, one strand of DNA is *not* from mommy and the other from daddy. In the maternal chromosome, *both* strands of the DNA molecule are from the mother; similarly, both strands of DNA in the paternal chromosome are from the father. With respect to DNA Cooper states, erroneously, that "every organism's characteristics are determined by its DNA code, which cannot be broken.

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Tampering with DNA causes it to die....[R]andom mutations can never really take place" (p. 34). It is as if the fields of molecular biology and biotechnology do not exist, or that transgenic organisms do not exist.

There is the inevitable discussion that evolution could not occur because it defies the Second Law of Thermodynamics (Chapter 9). Of course, there is no discussion of enzyme-coupled reactions and the need to explain other biological processes, such as growth, that increase organization. In his discussion of entropy, Cooper considers what happens "when sugar gets wet" (p. 64). In solution "it is attacked by a variety of forces and unbalanced, changing it into a series of ever-simpler forms...alcohol, aldehydes, acetic acid, and carbon dioxide. Within a few days there is no sugar left, only a mixture of end-products. This is a common example of entropy at work" (p. 64).

What a peculiar example of entropy! We are never told what these mysterious forces are that attack the sugar molecules and degrade them into simpler forms. It is as if the sugar molecules break down spontaneously and rapidly into these new molecules. Nowhere does Cooper introduce the metabolic action of microbes that, in reality, provides the "variety of forces" resulting in the specific end-products—not to mention that in the breakdown of the sugar molecules some of the solar energy stored in the carbon-to-carbon bonding is captured as chemical energy resulting in a net gain of ATP. This energy is also used for maintaining the organism's physical integrity and homeostasis and for powering growth and reproduction. All of these activities work *against* entropy.

I do not believe that any purpose would be served by further demonstrations of the failings of this scientifically worthless book. To provide a point-by-point refutation would require time and energy equivalent to writing another book. It is not worth the effort. In closing, I will paraphrase Cooper's closing remarks. As I close this review, I must utter a sad parting word to the originator of this book: Goodbye, *Goodbye Darwin*. C/E

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Book Review

The Dechronization of Sam Magruder. by George Gaylord Simpson, St. Martin's Press, New York, 137 pages, $17.95. Introduction by Arthur C. Clarke; afterword by Stephen Jay Gould.

Reviewed by Yves Barbero

Ten years after her father's death in 1984, Joan Simpson Burns, the daughter of the great paleontologist George Gaylord Simpson, discovered his unpublished short novel and decided to do the world a favor by having it published. She did us all a *great* favor, because Simpson's novel is a terrific read on many levels. Simpson was, of course, one of the great paleontologists of his generation. But beyond his commitment to scientific accuracy, Simpson brought that spark that elevates a novel to literature, revealing his inner emotions.

Stephen Jay Gould in his afterword said, "... as good as anything Sartre, or any of the French existentialist writers, ever composed on the ineluctability of being alone and responsible for one's action." The plot is relatively straight forward. A Twenty-second-century man, Sam Magruder, is thrust back 80 million years to live among the dinosaurs of America's Southwest. As an expert in time physics, he knows that he can never return, so he manages to leave some stone tablets in a swamp that are recovered in his own century.

Simpson's rich descriptions of the Cretaceous landscape and life forms, combined with the detailed inner landscape of Magruder's mind, are what makes the novella (it is a very short work that can be read in one or two sittings) really work. The introduction by Clarke (one of Simpson's favorite writers, according to his daughter) is very useful for those who are not familiar with the fabric of time travel tales, and the afterword by Gould (one of Simpson's former students) is also very helpful to those of us who lack background in paleontological debates.

The book is a full evening's pleasure. It is engaging despite the fact that science fiction aficionados might not find it quite "genre." But, in this case, the book would probably not have been as rich as it clearly is if Simpson had attempted to fit it into the science fiction genre. I think it compares favorably with those tiny but rich works that appear from time to time, like *Flatland* by Edwin A. Abbott, and the better known *War of the Worlds* and *The Time Machine* by H. G. Wells. Perhaps we should use Simpson's own term, "scientifiction," to describe it.

C/E

Yves Barbero is the author of *The CTZ Paradigm* (Doubleday, 1975). He has a keen interest in both science fiction and science policy.

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About this issue . . . continued from inside front cover

Neil Wells provides an extended essay that reviews *Darwinism: Science or Philosophy*, the proceedings of a 1992 symposium convened by UC Berkeley law professor Phillip Johnson. The articles in this book provide perspectives from *both* evolutionists and anti-evolutionists, and Wells reflects on the quality and the relative success of the arguments.

Our book reviewers have also been active. Jon Marks reviews a volume in honor of the life and work of Ashley Montagu by Larry Reynolds and Leonard Lieberman. Although we may tend to think of Montagu mainly in terms of issues of race and racism in evolutionary biology, this volume shows that his impact on evolutionary biology is far-reaching and comprehensive.

Frank Sonleitner reviews an extremely readable and informative book on geology by NCSE supporter G. Brent Dalrymple. He recommends this as background reading for all nonspecialists who need or want to know about the study of the age of the earth.

Andrew Petto reviews an older edition of Richard Wright's book, *Biology Through the Eyes of Faith,* which Wright is currently revising. This book presents the views of a Christian who is also an evolutionary biologist and explores how the two combine into the teaching and scholarship that define Wright's life's work.

In this issue we also present reviews of two works for young people. Thor Henrich reviews *Planet Ocean, a Story of Life, the Sea, and Dancing to the Fossil Record.* This book provides accurate information about the history of life and some of the geological contexts in which we find this information. Needless to say, this is a book that we all recommend and that can be ordered directly from NCSE.

Sheldon Gottlieb reviews the second book for young people, *Goodbye Darwin: A Handbook for Young Adults* by Art Cooper. Cooper's 100-page handbook is a guide for young people who wish to dispute and disprove evolution. As if accusing biology of being evolutionist is not enough, Cooper tells us that Marxists and communists have embraced evolution and that the recent collapse of those regimes demonstrates the imminent collapse of academic programs based on evolutionary biology.

Finally, for something completely different, Yves Barbero reviews the posthumous publication of George Gaylord Simpson's *novel*—yes, novel!—*The Dechronization of Sam Magruder*. For those who cringe at the prospect of a scientist's writing a novel, Barbero tells us that Simpson has succeeded where so many of his colleagues might be expected to fail.

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